SEWERAGE OF EUROPEAN CITIES.*

PARIS.

Population.—In 1880, 2,100,000; average density, 96 persons to 1 acre; the old city has as many as 313 to 1 acre: the outer districts, Gobelins and Observatoire, 45 and 61, respectively, per acre.

Area.—Inside of fortifications, 19,281 acres; circumference, 32,330 meters, or over 20 miles; greatest breadth from north to south, 5½ miles; greatest breadth from east to west, 7 miles; areas covered by public streets, 3,706 acres; areas covered by rivers or quays, 1,087 acres; areas covered by cemeteries, 222 acres; houses, parks and gardens, 14,268 areas.

Dwellings.—Number of private houses, 74,740, containing 685,000 dwelling-rooms and 337,600 shops and work-rooms. Number of inhabitants per house, 30.8.

Water Supply.—Average per day:

	Gallons.
Watering and washing streets	28,713,200
Watering and sprinkling parks	9,477,740
Fountains	10,706,40
Public buildings, hospitals, etc	11,474,720
Private dwellings	32,141,960
Total	93,514,020
Minimum	78,714,000
Maximum	104,660,000

This quantity is divided up as follows:

	Gallons.
Vanne (spring)	26,414,000
Dhuys (spring)	6,603,000
Ourcq (creek)	34,338,000
Marne (river)	13,207,000
Artesian wells	184,900
Seine (river)	23,772,700
Supply not sufficient; it is desired to have	132,000,000
Present average, per head	50.2
Present average, per head, of spring water (Vanne and Dhuys)	15.6

which is intended for house supply only.

Mortality mean for ten years, 23.9. In VII Arrondissement (Elysée) it is 14 0. In XII Arrondissement (Gobelins) and XIV (Observatoire) 39.0.

Meteorological temperature:

	Fahrenheit.
Sixty years mean	+51.44
Highest known temperature, Aug. 26, 1795	+104.00
Lowest known temperature, Jan. 25, 1795	−10.30
Mean of yearly maximum for 180 years	+91.22
Mean of yearly minimum for 180 years	+14.36
During last 90 years average number of days in a year when the thermometer was below freezing	46.5
During last 90 years average number of consecutive days of frost per year	14.4
Depth of frost: Mean, 8 in.; maximum, 31 in.	
Rain:	
Mean annual, inches	23
Minimum annual, in 1733, inches	8
Maximum annual, in 1804, inches	27½
Average number of days per year when rain falls is	233
Mean humidity	69.0

Maximum rain storms: In summer often ¾ in. fall per hour.

1860, July 16, 38 millimeters in 20 minutes = .0750 in per minute.
1865, May 23, 26 millimeters in 20 minutes = .0520 in. per minute.
1866, July 16, 32 millimeters in 30 minutes = .0424 in. per minute.
1867, Sept. 20, 41 millimeters in 20 minutes = .0810 in. per minute.
1870, May 22, 26 millimeters in 60 minutes = .0173 in. per minute.
1872, July 27, 40 millimeters in 60 minutes = .0263 in. per minut:.
1879, Aug. 15, 16.3 millimeters in 40 minutes = .0164 in. per minute.
Prevailing winds, southwest.

Topographical.—Altitude of the Seine at Paris is 30.5 ft. above the sea. No part of the city is flooded by high water; both shores have stone embankments through the city. Fall of river at low water when discharge was 1,695 cubic ft. per second: for eastern extremity of Paris, 1:19,483; for center of Paris, 1:1343; for western extremity of Paris, 1:14,225. Flood discharge March, 1876 (highest), was 56,500 cubic ft. per second.

Physical.—Older part of the city is very closely built up, especially towards the north and south. The western part has broad streets, avenues, parks, etc. Length of streets, boulevards, etc., is: with trees, 136 miles; without, 415 miles.

Management of Public Works.

All public works are under control of an inspector-general and director, with a general office and corps of 26 persons. The main departments, each one of which has a chief engineer and a large corps of assistants, are as follows:

I. *Streets.*—For the general design and laying out of the city, its streets, parks, &c.; also for the registry of real estate property; also for the construction and cleaning of streets. Corps: 45 persons for design and registry; 314 persons for supervision, construction and maintenance.

II. *Lighting the City.*—Corps: 50 persons for design, construction and supervision.

III. *Parks and Boulevards* (landscape gardening).—Corps: 165 persons for design and maintenance.

IV. *Water Supply and Sewerage.*—Corps for general offices: 211 persons for design, construction and maintenance.

a. Water-supply: Chief engineer and corps.

b. Sewers, canals and sewage farm: Chief engineer, consulting engineer and corps for general work; special engineer for construction and maintenance of sewers and nightsoil service, with corps; special engineer for disposal of sewage and nightsoil, with corps.

V. *Tramways.*—For construction and service of passenger railways of the city.

VI. *Architecture.*—For construction and maintenance of all public buildings: 13 consulting architects, 12 regular architects, 60 inspectors, etc.

Paris Budget for 1881.—Ordinary expenses:

		Francs.
Interest on municipal debt, etc		99,308,308
Police		22,820,568
Public schools		15,343,118
Public charities and pensions		10,202,973
Contribution for maintenance of army		2,044,800
Interments		1,135,308
Public Works:		
General office	1,717,600	
Architecture and fine arts	4,669,700	
Public highways	22,312,050	
Promenades and lighting	8,901,980	
Water and sewer department	11,446,460	
		49,047,290
Other expenses		22,893,088
Total		229,605,453
Extraordinary Expenses:		
New streets and pavements		2,480,000
New buildings		3,960,000
Other expenses		4,040,000
Grand total		237,295,453 or $47,479,091

Design and Construction of Sewerage Works.

General System and Alignment.—Transitional state at present. Four-fifths of all excrementitious matter is collected in water-tight vaults (fosses fixes) or in movable casks (fosses mobiles) and is periodically removed to a distant locality. The remaining quantity, which is increasing, is collected in casks (fosses filtres) which retain solids but permit liquids to escape and flow into sewers. They are exchanged at less frequent intervals and their contents disposed of in a similar way. All waste water from houses and streets, together with rain, are carried into a system of sewers. Its extent, as a uniform system throughout, excels that of any other city. Paris is divided into three main drainage-areas from which the sewage is carried entirely out of the city, and each one of which has a main collecting or intercepting sewage (collecteur général). Besides these main collectors there are about 16 secondary ones discharging into them. The remaining are the "ordinary" sewers. In all streets above 65.5 ft. in breadth double lines of sewers are built, one under each sidewalk, and in narrower streets they are built in the center. The ordinary sewers follow the valley lines as much as possible, and are all large enough to be walked through. No pipe sewers are used. The entire system was designed by M. Belgrand.

Shape and Size of Sewers.—The smaller or ordinary sewers have a shape approaching the oval, but with a flat, segmental invert, varying from 16 to 24 in. in width. The larger sewers or collectors have a banquette on one or both of the sides of the invert (cunette) high enough to be above the ordinary flow and broad enough to be walked upon. The main collectors have an invert about 11 ft. wide and 4½ ft. deep, in which specially constructed cleaning boats (bateaux vannes) are floated. The secondary collectors have inverts 47¼ in. wide and 31 in. deep, with iron rails at their edges upon which the cleaning-trucks are run. The arches of the sewers covering the invert (cunette) and banquettes are semi-circular. All sewers are built large enough for men to walk upright in them, even the house branches, which extend to the point where the vertical soil and other pipes descend. Pipes for the water supply, pneumatic tubes and telegraph wires are inside of the sewer and attached to the arch. When the grades are small, the type is determined through the following formula, which is derived from Prony's formula: Mean radius × slope = coeff. × square of velocity, and the assumption that the greatest quantity of rain falling in Paris is 1.77 in. per hour and the time to reach the sewers is three times longer than the duration of the rain.

A = drainage area; a = section of sewer; r = main radius; s = fall per 1,000, all in metric measure; $a = \frac{0.0239A}{\sqrt{rs}}$.

When storm-water overflows can be had, proper allowance is made when using this formula.

Depths and Grades.—The depth of the ordinary sewers, unless grade demands it otherwise, is regulated so that they get a covering of at least 20 in., which brings their inverts at least 6 ft. below the surface. The depth of the invert (cunette) is at least 1 meter for the types cleaned by boats and at least 31⅛ in. for those cleaned by the tracks. The grade of the ordinary sewers is generally the same as that of the street; it is often rather steep. The large collectors are very flat, and are not self-cleaning owing to the large amount of silt which is washed into them from the street. Types 1 and 3, which are cleaned by boats, have a fall from .0008 to .0005. The ordinary grade for house branches is 0.03.

Junctions, Connections, Overflows, Outfalls.—The junctions of large sewers are not made in the English or Frankfort manner, but are as a rule rectangular chambers with cylindrical arch. Whenever possible an extra fall is to be given at every junction, so that no backwater is caused in the smaller sewer. The grade of large sewers at their junctions is also determined by the necessity of having the banquettes on the same level; the cunette or invert will therefore drop correspondingly. When two oval sewers join, a drop of 8 to 12 in. is given, if possible, to each. The highest ends of the sewers are placed as little below the surface as allowable. The house branches, at least 1 meter high, connect with the sewers generally at right angles, which does not seem objectionable, as the house sewage is usually brought to the main in terra-cotta pipes, bedded in the invert of the branch and discharged from a trap basin (cuvette). These pipes receive the house water and the fluid excrements of the "fosses filtres" where these are used. The branches from the sewer extend under the sidewalk and often under the houses to the back yards. Storm water overflows are placed along the river at a few places. There are three outfalls for the Paris sewage, one at Clichy, one at St. Ouen, and one at St. Denis, all on the banks of the Seine several miles below Paris. The outfall at St. Ouen is at an elevation to allow the sewage to run by gravity to the irrigation fields of Gennevilliers. The sewage from the lower areas discharges at Clichy at ordinary high-water level and its contents are now partially being pumped to Asnières, Gennevilliers, etc. Arrangements are being made to pump all of the sewage in the future.

Ventilation.—The Paris sewers are ventilated through the street-gullies and the outfalls, and occasionally through pipes terminating at roofs of buildings. No objectionable odor arises from the gullies into the street, nor is there much smell in the sewers, except from some irregularity, which is quickly removed.

Man-holes.—Man-holes (branchements de regard) are always entered on the side-walks, through side entrances to the sewer, never from the street. They are closed with a cast-iron cover, 2 ft. 7½ in. in diameter, and are descended by iron steps, fixed in the wall every foot. The floor of the side entrances is ordinarily, 1 ft. above the invert of the sewer, and slopes toward it with a grade of 0.015. Sometimes, in large sewers, carrying much water, stone steps are built instead. The height of the passage way is 6 ft. 7 in., its width at spring is 39 in., at bottom, 20 in. Man-holes are, generally, 164 ft. apart, which is not varied from, except when near a sidewalk crossing.

Gullies (street basins).—Gullies (branchements de bouche) have side openings in the curbs 39 in. long and 4 in. to 5 in. high in the center and 2 in. at the sides. Gullies are built at no regular distance. The flatter the grade the more frequently they are placed. They are not located at street corners, but in the block.

Pumping Station.—The pumping station is situated at Clichy, near the bridge crossing the Seine to Asnières. Its capacity is gradually being extended to correspond with the extension of the irrigation fields. The present works provide for only one-sixth of the sewage. There are two horizontal engines, one of 250 horse-power, the other of 150 horse-power. The larger engine raises 1,040,000 gallons per hour, in a day of 15 hours, at a cost of 52 cents per 1,000 gallons raised 36 ft., with coal costing $6.30 a ton.

Miscellaneous Structures.—The sewage crosses from the south to the north side of the Seine by an inverted siphon near the Pont de l'Alma. It is a double line of wrought-iron tubes each 1 meter diameter (39⅓ in.), 556½ ft. long, laid several meters below bottom of river. The head upon the siphons can be varied from 1.7 ft. to 7.8 ft. as it becomes necessary. No trouble has been experienced with it.

Materials and Construction.—Sewers are built of boulders of a coarse, gritty sandstone (*meulière*), found in neighboring diluvium. Lately, some have been built of concrete. Bricks are rarely used. Vitrified pipes are only used for house drainage. The *meulière* masonry, bedded at right angles to the inner surface, is plastered with rich Portland cement mortar to an exceedingly smooth and regular surface. The coating must have a thickness of at least ⅜ in. over the most projecting points of the masonry. The least thickness of coating of the invert and banquettes must be 1½ in.; the coating of the extrados of the arch must be ¾-in. The stones form only about 50 per cent. of the bulk of the masonry, and are intended to act rather as stones forming a concrete than to give much strength in themselves. The underground sewage carriers in Gennevilliers are built entirely of concrete; their strength is tested to a head of 26 ft. of water. The material is composed of 3 parts cement and 5 parts clean gravel and 5 parts sand in volume. The concrete sewers are partially moulded in the trench, and partially molded at the works and joined in the trench. The walls

* From Mr. Rudolph Hering's report to the National Board of Health.

of street inlets and other appurtenances are also built of *meulière* boulders, plastered to a smooth surface. Over the extrados of sewers the earth filling is generally 40 in., in exceptional cases it is 20 in. in streets and 5 in. on the sidewalks.

Statistics.

Area drained by main sewers, acres	15,939
Length of sewers in 1880:	
Main and interceptinz (collecteurs), miles	45
Branch (ordinaires), miles	348
Total, miles	393
Number of gullies	7,877
Length of gully connections, miles	25½
Number of man-holes	10,692
Length of man-hole side entrances, miles	14½
Length of house connections, miles	87
Usual length of branches to gullies or man-holes, ft.	8 to 9
Length of sewers necessary to complete system, miles	261
The least grade of street gutters is	0.005

In Houses.

Various methods of removal are practiced. A large number of houses have water-tight cesspools, from which the contents are removed by odorless excavators and taken to various establishments for utilization.

Another method is to collect the night-soil in movable casks (*fosses mobiles*), which receive solids and fluids as well, and which are exchanged at intervals varying from a few days to a few weeks. Their contents are taken to the same establishments.

A third method, the one which at present receives the indorsement of the city authorities, is to receive the night-soil into movable casks which permit the liquids to drain off (*appareils diviseurs* or *tinettes filtres*) and run into the sewers or cesspools. The retained solids therefore need a much less frequent removal (average 24 times a year), and are finally disposed of as before. The casks stand generally in the house branches or passage-ways accessible from the sewers, or where none have been built, in vaults.

Number of cess-pools, holding each about 4 cubic yards	86,000
Number of movable receptacles:	
Retaining both solids and fluids	17,450
Filtering liquids into sewers	13,000
Filtering liquids into old cesspools	10,000
	120,450
Number of houses connected with sewer by a passage-way or branch	25,238
By pipes	1,050
Number of houses having night-soil service	63,000
Daily amount of sewage discharged, cubic feet	9,288,165
Daily amount of night soil removed, cubic yards	2,150
Amount from tinettes alone, cubic yards	392

Since July 2, 1879, it is lawful for small houses to be connected with the sewers by iron or vitrified pipes 12 in. in diameter, with a least slope of .075, except in streets where travel is great and where the subsoil is soft and uncertain. Exhaust steam is not allowed to be discharged into the sewers.

Disposal of Sewage.

The night-soil removed from cesspools and in movable casks is disposed of at various points around the city, the most important being the municipal works at La Villette, where three-fifths of the total quantity is taken. Here the casks are placed upon canal boats and towed to Bondy. The night-soil from cesspools is delivered in large casks upon wheels, into which it is pumped at the houses. The contents are dumped into an extensive underground reservoir 108 ft. by 105 ft. by 13 ft. deep, and the liquids, which are about six-sevenths of the mass, including suspended particles, are pumped by a 25 horse-power engine into two iron conduits, 8 in. diameter each, and 10,500 yards long, to Bondy. The deposited solids are then loaded into casks and taken there by boat. The establishment of La Villette is well kept, the cellars are washed daily and are well ventilated. At Bondy the contents of the casks are dumped into basins and allowed to dry. The liquids pumped are also allowed to precipitate any solids, the residue in both cases being manufactured into poudrette. The liquids are distilled, and by the aid of heat and the addition of lime-water the ammonia is disengaged and is converted into sulphate of ammonia. The yield varies from 12 to 20 pounds per cubic yard of liquid. About 885 cubic yards of night-soil are daily taken to these various depotoirs.

The sewage proper of Paris is delivered at three points along the right bank of the Seine, at St. Denis and St. Ouen, where, at the latter place, it has an elevation sufficient to cross the river on a bridge and flow to irrigation farms on the plains of Gennevilliers. At Clichy, it requires pumping and is raised under a head of 30 ft., crosses the river on a bridge to Asnieres, and thence flows to the fields. About 60,000 cubic yards in summer and about 40,000 cubic yards in winter are now pumped daily and utilized. The rest flows into the Seine, which is strongly polluted as far down as Epinay. About 120,000 cubic yards of silt, supposed to be deposited from sewage, are yearly dredged. The sewage is led along roads and paths over the flat and sandy surface of the Gennevilliers district in channels, partially under pressure and partially open. The former are built of concrete, and have valves on the surface from which the sewage can be drawn. The sewage is applied either as broad irrigation (en colmatage) or in furrows (en rigoles) between long narrow beds 3 ft. in width. The latter is preferred. The position of the beds is changed every year, so that they are placed on the furrow of the previous year. The extension of the sewage carriers over the entire peninsula is gradually to be accomplished.

	Acres.
Irrigated surface in 1872	128
Irrigated surface in 1875	346
Irrigated surface in 1878	914
Irrigated surface in 1880	1,020
Area available	12,000
or one acre for 170 to 200 persons.	

No ill effects have been caused by the irrigation works. Since they were started, a new village, Gresillons, has sprung up in the midst of the territory, with a death-rate averaging only from 19.5 to 25.3. Irrigation was begun in 1869. It is intended in future to purify the sewage more by filtration through the soil than by irrigation alone. The two methods will be combined, however, as much as possible.

Maintenance of Sewerage Works.

1. *Appliances.—a. For Removing Night-Soil.*—Cess pools are cleaned by pumping the contents into cylindrical iron carts with a capacity of from 70 to 140 cu. ft. These, when full, are hermetically sealed and conveyed to the several depots, La Villette, etc., for disposal. The common "fosses mobiles" are strong wooden casks containing from 4 to 6 cu. ft. They are closed with a tight-fitting cover and taken to the depots in carts for disposal. The "tinettes filtres" are made of galvanized sheet-iron of a cylindrical form, 16 in. in diameter and 26 to 29 in. in height, with a movable screen to separate the fluids from the solids. They are connected by a movable bayonet-joint with the soil-pipe and by a small movable india-rubber pipe with the branch from the sewer. They can thus be readily removed, and after being tightly closed are rolled under a man-hole, hauled up, placed upon a cart and taken to the depots for disposal.

b. For Cleaning Sewers.—The appliances are as follows:

The "bateau-vanne" is a boat with a movable apron or scraper (vanne) of the shape of the invert, but an inch or two smaller, perforated with three small openings and suspended at the bow so that it can be raised or lowered. When it is lowered to within a small distance of the bottom the water rises behind it, and, besides propelling the boat, rushes with great velocity through the narrow opening and stirs up the sediment. This sediment, as it accumulates in front of the apron, is pushed forward by it through the rising head of water and thus brought to the outlet. It is used in types Nos. 1 and 3.

The "wagon à bascule," or tip-wagon, is a truck, into which the silt is thrown and carried to the outlet. The "wagon-vanne" is a truck running on rails about 4 ft. apart, and fastened to the edge of the "piedroit" (path). It operates exactly like the boat, in having a movable apron in front, by which the detritus is pushed down the sewer.

The "wagon ordinaires," are simple trucks for the sewers of an oval shape. The siphon crossing under the Seine at the pont d'Alma is cleaned by means of a ball of hard wood 53½ in. diameter, 5.9 in. less than diameter of pipe, and weighing 187 lbs., which is passed through it at intervals, generally once a week. It is pushed along by the force of the water, and by being lighter it rolls along the soffit, which increases the velocity of the water along the bottom and causes the sediment to be scoured up and moved toward the outlet. It has been in use many years and given no trouble nor reason to anticipate any. There is a difference of level between the two ends of 1 ft. 8 in., and this difference can be increased to nearly 7 ft. by damming up the water at the southern end. A great velocity for simple flushing and for passing the ball is thus obtained. After the ball is inserted at one end it requires generally but a few minutes to appear at the other, pushing the silt in front of it. With a head of 1 ft. 8 in. its velocity is about 3 ft. per second.

The condition of the sewers is generally clean and no strong, disagreeable odor prevails except in the sewer which brings the foul waters from the Bondy establishment. During the summer months visitors are weekly taken through the large collectors in a cleaning-boat.

Cost of Sewerage Works.

Management and Maintenance.—Department for sewerage in 1879:

Corps for design and construction	$193,936
Materials and labor (exclusive of new work)	973,900
146 persons for inspection of cleaning sewers and night-soil service	71,000
Extension and repairs to city sewerage	420,000
Construction of house branches	28,000
Maintenance of sewers:	
Public sewers, flushing, etc.	243,200
House brances (reimbursed to city)	76,000
Public buildings, including night-soil removal	45,400
Dredging sludge from river	36,000
Miscellaneous	20,400
	$421,000
Utilization of sewage at Gennevilliers	78,000

Department for water supply in 1879:

Total expense, 5,860,280 francs=$1,172,056.

Annual cost of cleaning sewers per head of total population, 12.5 cents.

Annual cost of pumping sewage per head of total population, 4.5 cents, or about one centime for one cubic meter pumped.

Annual cost of night-soil service per head of population, 55 cents, or $1.23 per cubic yard.

Annual cost of pumping night-soil to Bondy, 2.92 cents per cubic yard.

Annual cost of transporting casks to Bondy, 7.32 cents per cubic yard.

Soil-pipes in houses supplied with the filtering casks are taxed with $6 annually. The removal and exchange of one cask is charged to owners with 30 cents. There is an average of 6.3 exchanges per annum. Therefore annual cost is about $1.90. Proprietors pay for the construction of house branches. Cost of the sewage purification works from 1869 to 1880 was about $600,000. Cost of maintenance and studies up to 1880 was about $600,000.

Rent of ground before sewage irrigation (1868) per acre	$12.15
Rent of ground after irrigation:	
1872 per acre	12.80
1875 per acre	17 28
1877 per acre	24.00
1880 per acre	36.00

Construction.—Estimated cost of existing sewers is $20,000,000, including 355 miles of main and branch sewers and 123 miles of house branches.

Estimated cost to complete the system is $8,911,100.

ANNUAL REPORT OF THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.

JAN. 17, 1882.

ADDRESS OF THE RETIRING PRESIDENT.

To the Members of the Engineers' Association of Western Pennsylvania:

GENTLEMEN: It is a matter of real regret that I am obliged to be absent from our annual meeting.

In reviewing the past year I see nothing but encouragement for the future.

The attendance at the meetings, averaging 46, is very remarkable, and shows a sustained interest in our proceedings which I believe is not equaled by any society in the country. A monthly attendance of over twenty per cent. of our whole membership shows a lively interest which simply means that our Society is a grand success and that it has filled a great want in our busy community.

I can say without flattery that in the last two years I have frequently wondered where all of the members came from and why they came together.

This only shows that the great growth of our city has not been properly realized by the natives, and that the need of friendly intercourse has in consequence not been provided for.

It is a matter of sincere congratulation that in the two years of our existence we have never had a meeting without a paper, and generally a good one, and sometimes very good ones; also that we have never incurred any debt, and that we now have a balance in the treasury which will justify the incoming board in having our Transactions printed in a little better form than before.

To be out of debt is to be successful, and I have no doubt that the new board will manage as carefully in this respect as has the old one.

A library of some 300 volumes of carefully-selected technical works, all paid for, is no mean achievement, and your library committee, now to be replaced by a permanent committee, deserves your regard for the large amount of work and care they have given to the selection of these books.

The reports of the secretary, the treasurer and the Committees on Library and Tests will give you full information of the details of the work of the year.

It is a pleasant duty to bear testimony to the zeal, industry and care which have been used by the Secretary and Treasurer in conducting your affairs, and I feel it to be especially due to your Secretary, who has added to his ordinary duties those of librarian and secretary of the general committees. To his unremitting attention, care as to details and exactness in records, is largely due the success of the Society, the smooth running of its machinery and the general good condition of your affairs.

The Board of Direction has met frequently and has considered all of the business of the Society with great care, and the proof of this is in results; everything has been well done, and we "owe no man anything but to love one another," and here

is your greatest achievement: you have organized, held your meetings, pursued steadily the objects of the Society; many friendships have been formed; questions have been discussed freely and fully, and not one word of discord has entered our councils either in public or private.

Gentlemen: This is better than wealth or glory. In retiring to the ranks of private membership I do not know how to thank you for the unvarying kindness and courtesy with which I have been treated, I can only commend my successor to the same good will and indulgence, and I can only add that I mean to still be with the Society and to work with all my might to make things as lively as possible, so that our worthy "God love" may never have a chance to go to sleep, and that we may all remain alert to our mutual interests is the best wish of Your "retiring president,"

WM. METCALF.

The Treasurer, Albert E. Frost, reports total receipts for the year ending Jan. 17, $1,053, and expenditures $865.12; for the Library Fund, receipts $1,500, and expenditures $1,290.07, leaving a balance of $209.83, to which is to be added a donation, not yet collected, amounting to $500, giving to that for Library $709.83.

To the Board of Direction of the Engineers' Society of Western Pennsylvania:

GENTLEMEN: I take pleasure in presenting my annual report for the year ending Jan. 17, 1882. The past year, the second since the organization of the Society, has been a very successful one. At the time of my last annual report there were 190 names on the list of members, to which there has been added 57, making a total of 247. During the year two have died and 24 have resigned, leaving now on the list 231, or a net gain of 31. During the year the Society has held nine regular and one adjourned meeting. The dates of the meetings, with the membership and attendance, are as follows:

	Membership.	Present.
January 18, 1881	196	53
February 22, 1881	196	42
March 15, 1881	206	60
April 19, 1881	221	61
May 17, 1881	237	54
Septem. 20, 1881	236	14
Septem. 27, 1881	236	20
October 18, 1881	237	38
Novem. 15, 1881	239	45
Decem. 20, 1881	244	55
Total		462
Average attendance		46

The following papers have been read during the year:

Feb. 22, Notes of a Trip Through the James River Valley. By Mr. Jos. D. Weeks.

April 19, Pittsburgh Sewer System. By Geo. H. Brown.

May 17, Discussion of Mr. Brown's Paper.

Sept. 27, Discussion continued.

Oct. 18, Some Wastes of Heat. By Mr. Wm. Metcalf.

Nov. 15, Electricity. By Mr. Jacob Reese.

Dec. 20, an illustrated lecture, by Prof. A. E. Frost, on Radiant Matter.

Description of the Coffer Dam and Means of Puddling at Davis Island Dam. By Mr. William Martin.

The Society, in exchange for its publication, has received the following:

The Committee on Room has continued the arrangements with the Pittsburgh Library Association on the same conditions as for the last year, viz., the Engineers' Society to pay $400 per year to the P. L. A. for the use of a room in which to hold nine monthly meetings, and the members to have the privileges of the library. The P. L. A. have agreed to spend the $400 paid in the purchase of engineering periodicals, but in this they have not fully complied. The following are the papers ordered in this connection at a total cost of about $115; quite a number, however, were on the library tables before any agreement was made between the two societies.

Transactions of the American Society of Civil Engineers for January, February, March, April, May, June, July, August, September and October, 1881.

Journal of the Society of Arts, weekly, from Jan. 1, 1881, to date.

Proceedings of the Engineers' Club of Philadelphia, Vol. II., Nos. 1 and 2, Feb., 1881.

List of Members, Constitution and By-Laws and Papers of the Pi Eta Scientific Society, Troy.

Transaction of the American Institute of Mining Engineers, Oct., 1881.

Proceedings of the Boston Society of Civil Engineers, May, 1881.

Proceedings of the Western Society of Engineers, Feb., 1881.

Abstracts of Papers in Foreign Transactions and Periodicals.

Papers from the Journal of the Franklin Institute.

The American Engineer, December, 1881.

Engineers' Club of Philadelphia.

Journal of the United States Association of Charcoal Iron Workers, August, 1881.

Contributions to the Theory of Blasting or Military Mining, by H. Hofer, Part Second, 1881.

Examples of Structures built by the Keystone Bridge Co., Pittsburgh.

Improvement on Non-tidal Rivers. Col. Wm. E. Merrill.

A large number of specifications of work let in 1881 by the various engineer officers from Maine to California.

Anales de Sociedad Cientifica, Argentina, Buneos Aires for February, March, April, May, June, July, August, September and October, 1881.

Ingeniors Foreigneus Forhandlinger, Stockholm, 5 numbers, 1881.

Revistu de Obras Publicas e Minas Publicao Mensal du Associacao Das Enginheiras Civis Portugues, 1881.

1. American Architect and Building News.
2. American Gaslight Journal.
3. American Engineer.
4. Engineering and Mining Journal.
5. Engineering News.
6. Railroad Gazette.
7. Railway Review.
8. Scientific American.
9. Scientific American Supplement.
10. American Journal of Microscopy.
11. American Miller.
12. Bulletin Iron and Steel Association.
13. Carpentering and Building.
14. Eclectic Engineering Magazine.
15. Journal of Chemistry.
16. Journal of Franklin Institute.
17. Manufacturer and Builder.
18. Milling and Mechanical News.
19. Plumber and Sanitary Engineer.
20. Engineer. London.
21. Engineering.
22. Annales des Mines (Bi-Monthly).
23. Annales des Ponts et Chaussées (Monthly).
24. Anna'en der Chemie (Monthly).
25. Civil Ingénieur (8 Nos. a year).
26. Journal fur Praktische Chemie.
27. Polytechnisches Journal (Fortnightly).

During the year the Society has been called upon to part with two of its members, by reason of death, viz., Messrs. J. H. Reno and David Carlin. Suitable memorials have been prepared and entered upon the minutes of the Society.

Financially the Society has been a success, as will be seen by the report of the treasurer.

With the surplus on hand the Board expect during the year to publish the papers in a better form.

During the year the Board of Directors have held ten meetings.

Respectfully submitted,

J. H. HARLOW, Sec.

REPORT OF THE LIBRARY COMMITTEE.

Mr. Wm. Metcalf, President Engineers' Society of Western Pennsylvania:

SIR: On behalf of the Committee on Library I have the honor to submit the following report:

As stated in the last annual report of this committee, each one of its members was constituted a sub-committe to prepare a list of books in a special department of technical literature.

Carefully prepared lists were thus obtained, including such works as were considered indispensably necessary for laying the foundations for a library of books upon applied science.

The committee has held a number of meetings, and after a comparison and revision of the lists submitted by its members it was decided to appropriate as follows:

Bridges and structures	$280.00
Railroad engineering	220.00
General natural science	200.00
Metallurgy	300.00
Tests of materials	200.00

Complete sets of the two French periodicals, the "Annales des Mines" and the "Annales des Ponts et Chaussées," have been obtained at a cost of $260.

Bids were obtained of several Eastern publishers and dealers, and the books purchased of the lowest bidder, at a large discount.

A list of the books has been printed and is now in the hands of members. The committee has at all times invited suggestions from members as to the selection of books, but very few suggestions were received.

Following is a statement of the finances:

Donation of Mr. Wm. Thaw		$1,000.00
Donation by a friend of the Society, $1,000, of which there has been received	500.00	
Subject to draft	500.00	
Total		$2,000.00
Expenditures for books		1,290.17
Leaving a balance of		$709.83

This balance the committee has decided to dispose of as follows:

Chemistry	$300.00	
German Engineering Works	100.00	
Mining Engineering	150.00	
Thermodynamics	50.00	
Hydraulics	50.00	
Leaving still a balance of	$59.83	$709.83

According to the arrangement entered into with the Pittsburgh Library Association June 15, 1880, it was agreed that the $400 to be paid by the Engineers' Society for the use of hall should be devoted wholly to the purchasing of periodicals of a scientific and technical character for the reading-room.

A number of journals have been added to the collection on the tables of the reading-room, but the cost of these new journals is estimated at $115.

Respectfully submitted for the committee.

FRANCIS C. PHILLIPS.

REPORT OF THE COMMITTEE ON TESTS.

To the President of the Society of Engineers of Western Pennsylvania:

SIR: The Committee on Tests, in the absence of any original work which it is able to lay before the Society, begs leave to submit the following statement of the affairs of the U. S. Commission for the testing of iron, steel and other metals.

In the year 1875, through the exertions of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Iron and Steel Association, and other scientific bodies, Congress created a commission to test iron, steel and other metals, and appropriated a sum of money for this purpose. The commission was composed of one engineer officer of the army, one officer of the Ordnance Department, two of the navy and three civil engineers, and began its labors very auspiciously. A number of tests were made in the government testing machine at the Navy Yard in Washington, chiefly on chain cables, and a report was published, a copy of which is in possession of the library of the Society. The chief fruit of the labors of the Commission, however, is represented by the admirable testing machine at the Watertown Arsenal which it had built, but the use of which it never enjoyed. Even before its completion the funds of the Commission gave out, and all efforts to obtain additional appropriations from Congress proved futile, except so much as was necessary to pay for the machine. After its completion it passed into the hands of the Ordnance Department of the Army, and by a law of Congress was made available to private individuals for purposes of tests on payment of costs. Extensive use has been made of this privilege, and the Department has also been able to make a limited number of tests on its own account. Among these are the tests on lined and unlined cast-iron cylinders subjected to internal pressure, copies of a report on which were furnished the Society through the kindness of Colonel Laidley, U. S. A., commanding Watertown Arsenal. Altogether a considerable number of tests have been made, and much information of value could no doubt be gathered from them, but very little has been published, and they as yet await the hand of some one who will work out the results systematically, and give proper interpretation to them.

Your committee is happy to state that active steps have been taken by the American Society of Civil Engineers, aided by other societies, in effecting a reappointment of a commission and securing an appropriation from Congress. At the meeting of the American Institute of Mining Engineers at Washington next month an united effort will be made to interest members of Congress in the subject and obtain favorable action during the present session of Congress. It is expected that the new commission will be placed on a better basis than its predecessor, that its powers will be greater, and that certain errors of organization which impaired the usefulness of the former commission will be avoided. There is every prospect that these efforts will meet with success, and the near future will see this, the most promising movement made in many years toward advancing our engineering knowledge, again under way and accomplishing results.

The committee regrets that one of its members, Mr. Kent, has been seriously ill for several months, and still continues so, in consequence of which his signature does not appear.

Respectfully submitted,

C. L. STROBEL,
J. W. WALKER,
Members Committee on Tests.

PITTSBURGH, Jan. 17, 1882.

THE ANNUAL BANQUET.

The second annual banquet of the Society was held at the Monongahela House on the evening of the 7th, and was fully as enjoyable as those concerned could possibly desire. When men whose brains are employed in the perfecting of huge undertakings, in the creation of enduring forms in iron and stone and wood, lay aside for the moment their graver duties, their hours of relaxation are marked by keen enjoyment, ready wit and polished speech. Such was the case in this instance. The banquet table was surrounded by members and invited guests shortly before 9 o'clock, and for three hours the elaborate *menu*, and the higher pleasures of thought and speech were alternately enjoyed. At the head of the table sat President Gottlieb, portly, gray-whiskered and urbane; at his right

Continued on Page 68.

ENGINEERING NEWS.

GEO. H. FROST.....PROPRIETOR.

Tribune Building, New York City.

JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
A. D. V. BURR..... .....ASSOCIATE EDITOR.

SATURDAY, FEB. 25, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

THE AMERICAN WATER-WORKS ASSOCIATION.—The second annual meeting of the American Water-Works Association will be held in the City Hall, Columbus, O., on Tuesday, March 14, 1882. J. H. DECKER, Secretary.

SENSATIONAL SCIENCE—THE IMPURITIES OF WATER.

We learn from the London *Architect* that at a meeting of the Institution of Civil Engineers, on the 24th inst., Mr. C. Falkard pointed out that "mere dilution had an almost inappreciable effect in disarming the germs of disease of their power. Now, supposing a glass of water to contain but one germ, if the person were weakly or sufficiently unhealthy, he would contract the disease almost as certainly as if there were hundreds of germs." According to Mr. Falkard, it will be impossible to banish zymotic diseases from towns, the water supply of which contains the dejecta of persons suffering from disease, *even though present in the most minute quantity.* "The very weakly contract the complaint from the water, and from them it will spread to the most robust around them, the germs being endowed with such persistent vitality that they withstand the effects of heat and cold, moisture, drought and chemical agents to an almost incredible extent, affording what seemed at first sight indisputable evidence of the now exploded docrine of spontaneous generation."

At a meeting at the Academy of Medicine in this city a short time since (N. Y. *Herald*, Feb. 2), Prof. Doremus demonstrated how the densest stone walls are easily penetrable by the gases of decomposing vegetable or animal matter, and, according to the reported proceedings, "he took a solid-looking section of the finest Philadelphia brick, 8 in. thick, and blew out a candle by the force of his breath through the apparently impenetrable thickness of the brick!" And at the same meeting Dr. Willard Parker, after acknowledging that the penetrative power of the fatal gases, as exhibited by Prof. Doremus, had been previously unknown to himself, stated that "previous to the introduction of the Croton water in 1842 no diphtheria was known in this city!" "and if he were to build a house now, he would have no connection with the sewers," and concluded by stating "that New York was in an exceedingly critical condition in this respect, and the time had arrived for energetic action."

We of course believe that a disregard of the plainest rules of hygiene will be likely to be attended with a lowering of the tone of the individual system, and if persisted in will sooner or later destroy the health and very possibly, in some cases, result in premature death. But we do not believe that the varying death rate shown by the bills of mortality in cities is attributable solely, or largely, to the varying condition of the public sewers with reference to the dissemination of sewer gas. The mode of life, better food and clothing, more of it, comparative exemption from the depressing influences attending a struggle for bare existence, all these improved conditions and others which could be cited, give a sufficient explanation for the fact that the death rate in localities has decreased in spite of the influence of certain new conditions which the comforts of modern life in cities have rendered necessary, but which the sensational scientist loses no opportunity to hold up to the public as attended with the extremest danger. Pure air, pure water, wholesome food, cleanliness, the prompt removal from dwellings of decaying organic matter, the prevention of crowding in the dwellings of the poor, the establishment of hospitals to which patients laboring under infectious diseases shall be removed for medical treatment—these are the requisites to a proper sanitary condition, and yet with all these requisites in the highest possible condition attainable, experience has shown that what sanitarians consider as a preventable disease may yet step in, no one knows how, and decimate such a locality in spite of the best medical treatment. Look at the ravages of the cholera. A surgeon of great experience in the English army in India, and subsequently in charge of the Cholera Hospital in Quebec when this plague visited the country in 1832, informed us that about the same percentage of the population were taken sick, and *precisely* the same percentage of the taken sick died, in either case. In the one, a total absence of all remedial agents whatever, and the climate and the surroundings in the highest degree conducive to the spread and severity of the disease; while the other, replete with every aid which science could afford, and a climate and surroundings such as might be selected for favorable treatment of disease, yet the result was the same. Every physician of experience has witnessed in his own practice similar instances of the potency of disease and the impotency of safeguards to its approach, and of medical treatment toward arresting its ravages; and yet there is nothing more certain than that the advent of this special disease is preventable; but its proper treatment, when at its height, is yet a matter of opinion, from the fact that, while the occasion of the disease in many cases appears obvious enough, its cause is as yet beyond our ken. In other words, the theory—or, we should say, the hypothesis—upon which the propagation of diseases of a zymotic type are based, is faulty; and when we state as a fact that, setting aside minor differences of opinion, which would increase the number materially, there are no less than *four* distinct theories of the causes of diseases of this character, all sustained by highly respectable authority, it will be apparent that preventive measures against the approach of disease are at least liable to some uncertainty of successful application; and yet we must admit it to be true that, so far as our limited vision extends, the means resorted to, or recommended, by the advocates of either of these theories of the progagation of disease, as precautionary measures, would possibly prove equally efficacious, whichever theory was correct; precisely as if, when the cholera was raging in Cadiz, we will say, if the authorities of Charleston were so thoroughly energetic as to prevent absolutely all communication between the two cities, upon the supposition that the yellow fever raged in Cadiz, their efforts might prove successful in keeping out the disease, notwithstanding they had wholly mistaken the nature of the disease.

But this would scarcely be satisfactory to the modern searcher after truth, and therefore we dwell upon the fact that Mr. Falkard talks of one germ being as potent for mischief as hundreds of germs, in the case which he supposes of the contamination of water, complacently regarding the germ theory of the propagation of disease as conclusively established as a fact in nature. Now, while the fact is too patent to be denied that poisoning by bad water is well established, it is far from proven that the occasion of the disease in human beings in drinking bad water arises from a living germ, conveyed by the water; and which germ, derivable from a putrefactive process, is almost immortal in its nature; at least no limit is set to its duration after birth, and is invulnerable during its lifetime to such assaults as extremes of heat and cold, moisture or drought, or corrosive acids, and will still retain the vitality essential to its own reproduction, and to an almost incalculable extent, so that when the surroundings are favorable, myriads of similar germs are propagated, each with the same potency for mischief when taken into the human body. If this be so, is there any cause for wonder that one germ would be as fatal as hundreds? Or rather, is it not an occasion for wonder that such an occurrence as the presence of a single germ by itself in a tumbler of water should be even thinkable? Recollect, that all this time, no one ever saw one of these germs, or a family of one hundred thousand of them, it having been estimated that five millions of them would find ample room upon a small pinhead.

Should we venture to combine the dangers to our life and health as shown by Mr. Falkard, with the assumed wonderful fecundity of the disease germ, added to the difficulty as shown by Prof. Doremus of fortifying ourselves by even stone walls against his insidious attacks, and then learn from Dr. Parker that, owing to the introduction of the Croton water, with the attendent circumstances above noted, the most fearful results might be apprehended as likely to occur at any moment—we might well pause aghast.

If the science of the age has at an enormous expense brought to our doors the Croton water, of which we are debarred the full benefit by reason of the incalculable swarms of deadly parasites with which it brings us into contact, and against which the densest stone wall will prove an insufficient barrier, we can scarcely hope for more than to wage a losing battle with these invisible antagonists, and finally, in common with the whole human family, succumb to their assaults. But, thank Heaven, there is a balm in Gilead and a physician there equal to the occasion. Nature herself, who builds up and tears down through inexorable law, has established a just balance between opposing forces, and has decreed the precise bounds beyond which none of her products can go. As an illustration: It is estimated that a single female of the cod species would, in twenty years, if not preyed upon by other than man, succeed in stocking the Atlantic Ocean beyond its capacity for other uses! So it has been decreed that the waste of organic life shall, after undergoing a natural transformation, support lives, which in their turn shall again be transformed to useful purposes; and to this end the vital principle, or oxygen, in earth, air or water, becomes the chief agent.

Some twelve years since, a commission of scientific men was appointed to inquire into the potobility of the Thames River waters, London. After taking the evidence of eminent scientists, engineers and others to an exhaustive extent, the report embracing the evidence was published in a folio of 760 pages exclusive of maps and plans. Dr. Chandler, late president of the New York Board of Health, and Professor of Chemistry in School of Mines, in a paper published by him in 1873 on the "Sanitary Chemistry of Water" quotes freely from this report in support of his own views. In refutation of Mr. Falkard and Dr. Parker's "Sensational Science" of a single germ in drinking water being sufficient to establish an epidemic of typhoid fever, we quote two extracts from Dr. Chandler's paper, one from the testimony of Dr. Angus Smith, a distinguished chemist, and the other from the report of the commission:

Dr. Angus Smith: "We do not know that the germs ever can be carried in pure water; the dissolved oxygen may destroy them, as it unquestionably does putrescent matters. A positive proof of their transmissions in otherwise pure water is wanting. * * * It seems probable that disease cannot be carried far by pure air, nor by water with much oxygen in it, which is equal to pure air. We are informed that the atmosphere is full of germs, but the evidence seems to be, that it requires an unusual excess to attack us successfully; it seems to be a question of quantity."

Report of Commission: "The organic contamination of the Thames is much less than is commonly imagined, still it would be sufficient to do great mischief, were it not for a most beneficial provision of nature for effecting spontaneously the purification of the stream. Some of the noxious matter is removed by fish and other animal life, and a further quantity is absorbed by the growth of aquatic vegetation; but, in addition to these abstractions, important changes are effected by chemical action. The organic compounds, dissolved in water, appear to be of very unstable constitution, and to be very easily decomposed, the great agent in this decomposition being oxygen, and the process being considerably hastened by the action of the water. Now, as such waters always contain much air, dissolved in them, the decomposing agent is ready at hand to exert its influence the moment the matter is received into the water. * * * The effect of the action of oxygen in these organic matters, when complete, is to break them up, to destroy all their peculiar organic constitution, and to re-arrange their elements into permanent inorganic fumes, innocuous and free from any deleterious quality. This purifying process is not a mere theoretical speculation. We have abundant practical evidence of its real action in the Thames and other rivers."

We think the single germ in a glass of water, as well as the poisons to be apprehended from the copious Croton supply, need not excite our fears as anything more alarming than "sensational science."

THE MALARIA SUIT AT PITTSFIELD.

A large contest, involving a number of important points, was unavoidably, not to say unfortunately, postponed at Pittsfield, Mass., last month. Among other matters that will probably be determined when the case comes to trial will be the status and rights of mill-owners as against a probable injury to the public health by the manner in which their business may be conducted. On the other hand, the rights of communities to protection from diseases that may be prevented will have to be determined.

The case in point is simply this: The Smith Paper Company, acting under the laws of the State of Massachusetts, have constructed a dam in the Housatonic River, which although but eight ft. high set the water back in the stream for about seven miles, there being only a fall of eight ft. in this entire distance. As a matter of course such an obstruction in a stream of so little fall necessarily produces a large amount of soil saturation. The valley of the river at this point is from one-half to three-quarters of a mile in width, and an enormous marsh has resulted from the soil saturation. On both sides of the river the residents with scarcely an exception have suffered from some form of malarial disease, which is ascribed solely to the marsh. The inhabitants of Lenox, through the Town Committee, have brought an action against the Smith Company. That is to say, at their instance an indictment for maintaining a nuisance has been procured, and the trial on this indictment was the one that was postponed.

From an engineering standpoint the question turns on the proper method of impounding water for industrial purposes. It is well established that water for domestic use should only be impounded in a reservoir, from which all vegetable matter has been first removed. This is the only way to secure pure water, and the only way to prevent the reservoir from being a source of insalubrity to the neighborhood in which it is located. Undoubtedly for the same reason all reservoirs should be so constructed. It is true that this involves a certain amount of expense, not at all times possible to small capitalists and always onerous to large ones. Nevertheless in the rapid augmentation of population, sanitary questions of a serious character are coming to the front that require earnest consideration, and the rights of all must be respected in the conduct of any industry, no matter what the vested rights of that industry may be. We shall look with deep interest to the progress of this suit, as it is understood that a great deal of expert testimony of an important character is to be introduced.

UNIFORM CONVENTIONAL TINTS.

In reference to the subject of conventional tints for mechanical drawings: many years ago, before the day of uniformity in anything, we adopted for our own use, as the most suitable color, the local color in the shade of the material to be represented, and have so continued for over a quarter of a century. We now find by a circular of James W. Queen & Co., 924 Chestnut street, Philadelphia, that these very colors are sold in cake by them as "Standard Technical Water Colors." The colors named as copper, brass, steel, wrought iron, cast iron, brick, stone, wood, leather, are the very tints which we had selected and used as the nearest possible when applied in a thin wash, to the local color of the object, and hence better suited to the purpose than would be colors which were purely conventional.

SCIENCE.

A journal devoted to news, even though it be engineering news, is not thereby necessarily a scientific journal, but, notwithstanding, may with propriety be looked to occasionally for news of a scientific character, and hence, while acknowledging the paucity of our claims to being regarded as scientists, we can occasionally select what will be regarded by many of our readers as scientific *news*, and therefore make no further apology for inserting the following from the January number of the "Scientific Proceedings of the Ohio Mechanics' Institute:"

Professor Eddy read a paper upon "The Earth—Its Form and Shape." He explained how the earth's form resembles an orange, and the true form to which it approximates is defined as that which the earth would have were its surface all water. He explained how the true level varies in places, due to local attraction of large masses of matter, either upon the surface, or of greater density beneath. As an example, if a canal could be excavated through a mountain range, so that the sea water could enter it, the water level would be higher at the center of the range than at the sea, due to the "attraction of the mass of earth forming the mountains."

Having had occasion some weeks since to call attention to a late work of Professor M. Merriman, on the figure of the earth, and the geodetic operations from which it had been deduced, we stated, on his authority, that the figure of the earth resembled that of a potato. If we have unguardedly misled any of our readers upon this important point, we hasten to correct it, and assure them that we do not of ourselves pretend to know whether it most resembles an orange or a potato, but sure we are that it cannot resemble both orange and potato.

Assuming that the true form to which the figure of the earth approximates, is what it would have, were its surface all water, Professor Eddy explains the variations from this form which exist, "as due to local attraction of large masses of matter, either upon the surface, or of greater density beneath." As we understand the Professor, he does not refer in this to variations in the level of the land, but that variations in the absolute levels of the sea, marking its approximation to the surface form of an orange, are due to these attractions, and illustrates it by an example of a cut through a mountain range, say from ocean to ocean, wherein he says, "that the level of the water would be higher at the center of the range than at the sea, due to the attraction of the mass of earth forming the mountain." If this be so, as we doubt not that it is in mathematical symbols, then as a consequence, all waters which wash the shores of high mountain ranges, undergo this variation from the general law of hydrostatic level due the attractive force of the gravity of the *whole earth;* and mathematically, the shores of all continents and islands, instead of presenting a uniformity of sea level, as we had carelessly supposed they did, they really vary in absolute level, depending upon the attractive force of masses of matter in their vicinity.

The consideration of this important factor in the determination of the approximate figure of the earth has opened up grave doubts in our mind whether, indeed, the globe on which we dwell most resembles a potato or an orange. Superficial thinkers might regard this question as of little importance either way, and consider it about on a par with the computation of the bending moment, and consequent divergence of aim, occasioned by a fly lighting on the muzzle of a rifle. But in science nothing can be regarded as too little for its research.

Some of our readers must have seen an article published in the *Atlantic Monthly* in 1875, entitled "Old Times on the Mississippi," by Mark Twain, which, although not precisely engineering *news*, is most decidedly a *new* view to take of the possible errors which may grow out of a too strict adherence to figures merely; an extract from it will bear republishing for the benefit of some of our scientists.

"The Mississippi between Cairo and New Orleans was 1,215 miles long 176 years ago. It was 1,180 after the cut-off of 1722. It was 1,040 after the American Bend cut-off, some seventeen years ago. It has lost 67 miles since. Consequently its length is only 973 miles at present.

"Now, if I wanted to be one of those ponderous scientific people, and 'let on' to prove what had occurred in the remote past by what had occurred in a given time in the recent past, or what will occur in the far future by what has occurred in late years, what an opportunity is here. Geology never had such a chance, nor such exact data to argue from. Nor 'development of species' either. Glacial epochs are great things, but they are vague—vague. Please observe:

"In the space of 176 years the lower Mississippi has shortened itself 242 miles, that is an average of a trifle over 1⅓ miles per year. Therefore, any calm person, who is not blind or idiotic, can see that in the old oolitic silurian period, just a million years ago next November, the lower Mississippi River was upward of 1,300,000 miles long, and stuck out over the Gulf of Mexico like a fishing rod, and by the same token any person can see that 742 years from now, the lower Mississippi will be only 1⅔ miles long, and Cairo and New Orleans will have joined their streets together, and be proceeding comfortably along under a single mayor and a mutual board of aldermen. There is something fascinating about science, one gets such wholesale returns of conjectures out of such trifling investment of fact."

BROOKLYN CITY WORKS.

REPORT OF CHIEF-ENGINEER ROBERT VAN BUREN TO THE COMMISSIONER OF CITY WORKS.

As a matter of the first importance, attention is called to the water supply.

The average daily consumption for the year 1881 was 32,731,500 gallons. The maximum consumption was 44,720,440 gallons. The minimum supply from streams and ponds he estimates at 25,000,000 gallons, and from the new wells already built near Springfield and Water Pond 6,000,000 gallons more; and if a similar well be sunk between Jamaica and East New York, with side galleries, which will yield 5,000,000 gallons, of which there can be no doubt, the daily minimum supply may safely be estimated at 36,000,000 gallons, not including in this estimate anything obtained by storage in the Hempstead Reservoir. While this reservoir has accomplished all that was promised by it; that it to say, when the *minimum* flow of the stream was estimated as 20,000,000 gallons daily, it was assumed that a storage could be made from the winter and spring rains in this basin, which, held in reserve for supplementing the low summer flow, would for 100 days insure the 20,000,000 gallons daily being increased to 30,000,000. The reservoir has shown its capacity to accomplish this, but the exigencies of the water service have prevented this reservoir being regarded as a reserve merely for a limited time in the season of drought, and it has of necessity been included in the current operation of the works at all times and seasons precisely as any of the other ponds.

The use of the new wells from which the water is pumped into the conduit has proved so successful, even beyond the anticipations of the engineer, that it would seem feasible by their judicious use to bring up the supply to the capacity of the conduit, and at a less cost than by an extension of the work eastward or than by a general introduction of meters to endeavor to limit consumption in the city to the present amount of their water supply. The engineer recommends an appropriation of $250,000 to this end and shows its benefits over the meter system.

The length of sewers built during the year was 2¼ miles, and the engineer recommends the extension of the Third avenue sewer from Twenty-eighth to Fortieth street, at an estimated cost of $150,000, and the provision of storm water overflow to the lately completed Bond street sewer, and also recommends the use of the perforated covers for man-holes for the 300 miles of city sewers, which method of ventilation is now recognized as likely to take the place of any other.

He also repeats his recommendations of previous years, that a fourth engine and conveniences for its use be added to the present (three) engine power at Ridgewood at an estimated expense under $200,000, and also that the distributing reservoir at Ridgewood be enlarged proportionally to the increase in consumption of water, from a capacity of 160,000,000, as at present, to double that amount, or 320,000,000 gallons.

The extent of building last year was 2,000 houses, and the engineer broadly intimates that the indications of the prosperity of the city can in no better way be assured than by a liberal extension of such improvements as modern civilization calls for in great cities.

PERSONAL.

R. H. TALCOTT is chief engineer of the Richmond & Mecklenburg Railroad.

H. A. SCHWANECKE has been appointed chief engineer in charge of construction on the Pittsburgh & Western Railroad.

S. B. McKEE, late Locating Engineer on the Ontonagon & Brule River Railroad, Michigan, has been appointed Locating and Resident Engineer Credit Valley Railway, with headquarters at Toronto, Ont.

MAJOR S. HERSCHEL, of the royal engineers, son of the illustrious Sir John Herschel and grandson of the famous astronomer, Sir William Herschel, is now in Washington. He visits this country at the request of the superintendent of the United States Coast and Geodetic Survey—Prof. J. E. Hilgard—for the purpose of taking part in certain delicate pendulum observations for determining the exact force of gravity at this point; bringing with him for that object the pendulums which have been already used in the same service both in England and in India. Prof. S. F. Baird has offered the necessary facilities for these experiments, which will be conducted by Major Herschel, and Prof. C. S. Pierce, of the Coast Survey, in an apartment in the Smithsonian building set apart for the purpose. It may be well to state that the ultimate object of these very delicate determinations to be made at numerous points around our globe is to ascertain more precisely its figure, that is to say, its amount of deformation from a true spheroid of revolution, when reduced to a uniform sea-level.

THE IRON TRADE.

(Prepared Expressly for ENGINEERING NEWS.)

An unlooked-for contraction of operations of the Gould syndicate in regard to western roads diverging from St. Louis has had a dampening effect on the steel-rail market. Whether its curtailment of operations is to be of long duration cannot be known. The strange policy is a surprise to railroad builders, to investors and to the Western public, which knows of no reason why railroad construction should not be prosecuted vigorously. Perhaps there are too many roads projected—too much mileage—the completion of

which might compel an internal competition. Extensions and improvements have been stopped; some rail contracts have been cancelled; some lots of rails have been offered for sale. Mr. Gould's interference is not favorably regarded by many, but perhaps he is proving himself a public benefactor in checking undue activity in railway building, which so many are anticipating. It is not likely the Gould syndicate will build too few roads. It is possible that the individual concerns in the great Southwest, struggling for the control of prospective traffic, should build too much road. The Gould Huntingdon combination in the far Southwest has nipped projected construction in the bud. These movements are mere factors in the railway problem. The country nor the steel manufacturing interests cannot profit by any overdoing in railroad construction. The weekly announcements of new roads guarantee sufficient activity. The policy of no one combination of roads can seriously interfere with railroad construction. The country is too large for that. The very active demand for steel rails has pushed their price beyond fair limits. Foreign competition and the expanded facilities for production at home have recently brought about a needed revision of quotations. Large lots of Bessemer steel rails can be bought at $54 to $55. The decline has not attracted buyers, as might be expected, because of two or three facts. A further decline is thought probable. Deliveries cannot be promised, except at remote dates. Buyers, therefore, would prefer to wait and meanwhile profit by any favorable happenings. Nothing unfavorable can happen.

Foreign steel production is increasing rapidly. As long as continental and colonial demand keeps up the way is clear. Should it decline unexpectedly or gradually, American markets would very soon feels the effects in increasing competition and depressed prices.

The American merchant and construction iron mills are abundantly provided with orders, and prices are in the main stationary. Consumers betray considerable caution or prudence in anticipating requirements. They know that capacity on both sides of the water is increasing, and that in the long run a decline in prices is inevitable.

Blast furnace capacity is gradually increasing. Imports have not taken place. Ocean freights render exportation of crude or finished iron practically impossible. Large surplus stocks abroad continue to threaten our markets, but the probabilities of shipments on a large scale at an early day are remote. The steel works are crowded with orders at remunerative and improving prices.

Demand is increasing, particularly in the West, where steel for agricultural, mining and manufacturing purposes is growing in demand.

ENGINEERS' SOCIETIES.

THE AMERICAN INSTITUTE OF MINING ENGINEERS.

The annual meeting of the Institute was called to order at 8 p. m. on Tuesday, in the lecture-room of the National Museum Building, Washington, by President Metcalf. An address of welcome was read by General Sherman, which was supplemented by some remarks from Major J. W. Powell, Chairman of the Local Committee, after which President Metcalf read the announcements for the meeting. The members and ladies accompanying them afterward attended a reception given by Major and Mrs. Powell at their residence, where they had the pleasure of forming mutually agreeable acquaintanceships, and also an opportunity of meeting General Sherman, Vice-President David Davis, Senator Hoar, Spencer F. Baird and other gentlemen distinguished in the political and scientific circles of society.

Wednesday forenoon was devoted to the reading of papers and in the afternoon a special session was held in memory of the late ALEXANDER LYMAN HOLLEY, which was honored with a full attendance of members and visitors, and at which many eloquent addresses and numerous letters and cablegrams were read from the intimate associates of the distinguished engineer whose loss is severely felt by all who knew him.

The evening session was devoted to the special subject of discussing the testing of iron and steel and other structural materials preliminary to memorializing Congress on the creation of a Commitee on Tests of these materials. Papers were read and remarks made by Messrs. A. Welch, Chas. Macdonald, Gen. Meigs, Capt. Lyle of the Springfield, Mass., Armory, E. D. Leavitt, T. C. Clark, O. Chanute, A. P. Boller, T. Egleston and W. H. Paine. The subject was continued and other papers read on Thursday a. m., and in the afternoon of the same day the members and ladies accompanying were received by the President and afterward were accorded the special favor of being shown through the several parlors of the White House; they were next escorted through portions of the Treasury Building and were received by Secretary Folger in his office. In the evening over 100 sat down to the subscription dinner at Wormley's, which, like all social gatherings of engineers, was a pronounced success. Friday was given up to reading papers in the morning, and an excursion, as per programme, in the afternoon. The following papers were read at the several meetings:

A process for making artificial fuel from anthracite and bituminous coal dust, and the applicability of the process to the utilization and solidification of the slacking lignites of the West, by E. F. Loiseau, Philadelphia.

Southern fire clays, by Prof. P. H. Mell, Jr., Auburn, Ala.

Balance of Petroleum remaining in Pennsylvania and New York, by Henry E. Wrigley, Philadelphia.

Notes on the Luermann Front, by George Asmus, New York City.

A new Ore Pulverizer, by C. Henry Roney, Philadelphia.

The Crystalline Rocks of Virginia compared with those of New England, by Prof. C. H. Hitchcock, Hanover, N. H.

Contributions to the Metallurgy of Nickel and Copper, by Henry M. Howe, New York.

Comparative Efficiency of Fans and Positive Blowers, by Henry M. Howe.

Some Drift Deposits of Fossiliferous Hematites in Tennessee, by Edward Nichols, Ridge Valley, Ga.

Phosphorus Determinations in Pig Iron and Steel, by F. E. Bachman, South St. Louis, Mo.

Instruments for Projection Drawing, by Prof. J. M. Silliman, Easton, Pa.

The Gold-bearing Sands and Quartz Veins of the Jaina River, San Domingo, by R. P. Rothwell, New York City.

Note on the Result of the Blast in the Glendon Limestone Quarry, by Frank Firmstone, Easton, Pa.

Electrical Apparatus and Processes for the Mining and Metallurgical Engineer, by N. S. Keith, New York City.

Hoefer's Method of Studying Faults in Veins, by R. W. Raymond, New York City.

The Gold-bearing Conglomerates of the Black Hills, Dakota, by Walter B. Devereux, Globe, Arizona.

The Valuation of Iron Mines in New York and New Jersey, by Prof. J. C. Smock, New Brunswick, N. J.

Late Developments in the Siemens Direct Process, by George W. Maynard, New York City.

Chimney Draughts, by Prof. B. W. Frazier, Bethlehem, Pa.

Notes on some newly dicovered Mineral Regions of Southern New Mexico, by Prof. B. Silliman, New Haven, Conn.

Supplement III to a Catalogue of Official Reports upon Geological Surveys of the United States and Territories and of British North America, by Fred. Prime, Jr., Philadelphia.

First Aid to the Injured, by Prof. H. S. Munroe, New York City.

A Review of the Ste. Genevieve Copper Deposit, by Frank Nicholson, Ste. Genevieve, Mo.

Notes on the New Mill at Batopilas, Mexico, by J. C. F. Randolph, New York City.

On the Necessity of Government Aid in Organizing a System of Tests of Materials used for Structural Purposes, by Charles Macdonald, New York City.

Note on the Watertown Testing Machine, by E. D. Leavitt, Jr., Cambridgeport, Mass.

On the Effort to Organize a New Board for the Testing of Iron and Steel, by Alfred P. Boller, New York City.

The officers elected were as follows:

President. R. P. Rothwell.

Vice-Presidents, T. N. Ely, Altoona; C. Macdonald, New York; Major J. W. Powell, Washington.

Managers, Wm. Burnham, Anton Eilers, A. S McCreath.

Treasurer, T. D. Rand.

Secretary, T. M. Drown.

ENGINEERS' CLUB OF PHILADELPHIA.

Record of regular meeting held Feb. 4, 1882, at the rooms of the Club:

President Rudolph Hering in the chair.

Mr. Wm. A. Cooper presented a description of the progress in methods and contrivances for uniting the ends of rails, a subject of much thought among engineers, as the hundreds of patent fish-plates, chairs, nut-locks, etc., show. From wooden rails, spiked to sleepers embedded in the ground, an advance was made, about 1765, to iron straps nailed upon the wood to diminish wear. In 1767, at the Colebrookdale, Eng., Iron-Works, cast-iron rails, 4 in. wide by 1¼ in. thick by 5 ft. long, were laid. In 1789 cast-iron rails are said to have been set and bolted in cast-iron chairs fastened to sleepers, and in England the general method of wedging or bolting the rails to chairs fastened to the ties has continued to be the general practice.

In early American railroading, the strap rail of "snake-head" celebrity was used for economical reasons, but soon abandoned for the T rail. In 1847 the fish-plate or splice-bar, which has superseded, in this country, all other means of fastening, was designed. It consisted of a pair of plates 18 in. by 8 in. by ¾-in, bolted over joint by 4 bolts, 2 to each rail, with oval bolt holes to admit of expansion and contraction in the rail. A later improvement was the use of angle plates, giving greater support to rail and larger bearing surface, and admitting the spike slot in the plate, instead of the rail, to prevent creeping.

The remainder of the paper was devoted to the discussion of various forms of nuts and washers designed to obviate the loosening of the nuts and elongation of the bolts. A large number of specimens were exhibited.

Prof. L. M. Haupt read a paper upon "How to Establish a True Meridian," the object being to present the subject in a manner sufficiently clear and practical to be generally understood by those desiring to make use of such information. Explicit definitions and explanations, with applications to practical methods, are given in this paper, accompanied by azimuth, refraction and equation of time tables.

The Secretary presented, on behalf of Mr. Howard Constable, a description of a pneumatic pulverizer, which consists, in brief, of a chamber into which are introduced two injector nozzles, opposite each other, and each connected with a funnel for the reception of the material to be pulverized. By the expulsion of superheated steam through the injectors, the material, previously crushed to about the size of a pea, is forced into collision in the chamber, and about 95 per cent. thereof is thereby reduced to fine dust and carried by the exhaust into a settling chamber, the tailings being collected in the bottom of the chamber and returned to the funnels. By a 20-horse boiler, 120 lbs. pressure, 1¼ tons per hour have been pulverized, and it is expected to increase this to 2 tons per hour by a pressure of 200 lbs., and take the place of a 20-stamp mill which weighs about 4,000 lbs., while this machine proper weighs about 100 lbs. only. Specimens of quartz, in crushed fragments and powder, were submitted—the latter being almost entirely composed of an impalpable dust. It is designed to make use of this machine for pulverization in general.

HOWARD MURPHY,
Secretary and Treasurer.

LIVERPOOL ENGINEERING SOCIETY.

The second meeting of the session was held at the Royal Institution on Wednesday, the 1st inst., at 8 o'clock, the president, Mr. F. Salmon, M. I. and S. Inst., in the chair.

After the usual business, Mr. William Goldstraw read a paper on "Municipal Control of Streets and Buildings."

The author showed that from the earliest times the arm of power had been put forth in the control of streets and buildings, generally with much benefit to the community. Ancient Rome and medieval Europe were referred to for instances of restrictions in these matters. In Paris there had been building regulations of gradually increasing severity from the 13th century to the present day; and that city had now reached a higher standard in this respect than perhaps any other place. In England public control of buildings dated as far back as 1189, when twelve aldermen of London formed a court to assist the first Mayor in dealing with this special subject. After referring to the determined efforts made in the reigns of Elizabeth and James to impose limits on builders, the author dwelt on the rules for rebuilding London after the great fire of 1666. The act then passed was in many points the prototype of all building acts; in some respects it went further than modern regulations.

Since that period a large number of statutes had been passed to insure the health, safety and comfort of dwellers in towns. The author traced the history of these enactments and of many attempts to consolidate and amend them, and showed that both in London and the provinces the number and intricacies of the various laws and authorities on the subject were causes of great annoyance and perplexity both to officials, and persons to concerned in building. Municipal surveyors found great lack of information on the subject; and nearly every town had rules differing from those of another. The remedy he suggested was a general Building Act for the whole country. As a beneficial example the Public Health Act, 1875, was referred to. The author believed that the Model By-laws issued by the Local Government Board in 1877 would pave the way for a general statute; and that body appeared to be the only one able to frame and carry such a scheme. Architects and engineers could help on the desired end by procuring local enactments having features in com-

mon, and by speaking in concert on behalf of a comprehensive measure. The passing into law of the lapsed County Boards Bill, or of the expected County Government Bill, might create an immediate necessity for a general building act. Isolated effort could do little in such a matter. To the unsuccessful bill promoted by the Metropolitan Board of Works in 1874 must now be added a partial failure in our own locality. The City Engineer had recently put forward a complete proposal for the consolidation and amendment of the building regulations of Liverpool which might have formed a rough basis for a general act. This scheme, however, had been consigned to the limbo of unrealized projects.

In conclusion the author urged that as public opinion on these topics was ill-informed and indifferent it was the duty of those who knew the facts to attempt some improvement; and he called upon municipal engineers desirous of promoting the public interests, and a general increase of health, sweetness and light, to give this subject their earnest attention.

A discussion followed the reading of the paper, and a vote of thanks was given to the author.

The President announced that the next meeting of the society would take place on the 15th, when the discussion on Mr. Goldstraw's paper would be resumed, and owing to the importance of the subject a large attendance is anticipated.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 59.

CCXI.—LENOX.

Lenox, Massachusetts, in lat. 42° 20′ N., long. 73° 12′ W., is on a hill 1,200 ft. above tide level, in the center of the Housatonic Valley, and surrounded by mountains.

Settled about 1760, it was incorporated as a town in 1767. In 1875, water-works were built by a private company, after plans of George Murdock, taking the supply from mountain springs, draining a water-shed of 1¼ square miles. Three dams of stone, laid in cement, impound the water in reservoirs holding respectively 40,000, 500,000 and 165,000 gallons. The last named is the distributing reservoir, and is 100 ft. above the village. The water is filtered through stone and gravel, with fairly good results.

An additional supply in case of droughts is obtained by pumping into the reservoir from the river, 190 ft. below it.

Distribution is by cast-iron pipe of 4 and 8-in. diameter, of which 5½ miles are laid, with 5 fire hydrants, 8 gates and 115 taps. The town does not pay for use of hydrants. Service pipes are of wrought iron.

The population in 1880 was 1,400 and the daily consumption is estimated at 50,000 gallons.

The capital stock of the company is $22,000. The works have cost $25,000. Further financial statistics are not furnished. William D. Curtis is the Treasurer and Manager.

CCXII.—MONTICELLO.

Monticello, Iowa, in lat. 42° 15′ N., long. 91° 10′ W., is on the Maquoketa River. The town is on an elevated terrace, or what is called the "second bottom" of the river. Settled in 1853 it was incorporated in 1867.

Water-works were built by the town in 1879, after the plans of Thomas N. Boutelle, C. E.

The supply is taken from an artesian well of 5-in. bore and 1,200 ft. deep, sunk 40 ft. into the Potsdam sandstone and furnishing water of great purity.

A 6-in. Blake steam pump lifts the water 125 ft. into a circular reservoir or tank of stone masonry, holding 35,000 gallons, at 100 ft above the town.

Distribution is by 2 miles of 8-in. to 4-in. cast-iron pipe, with 20 fire hydrants, 7 gates and 80 taps. Galvanized-iron service pipes are used.

The population in 1880 was 1,800 and the daily consumption is estimated at 25,000 gallons.

The works cost $16,000. There is a bonded debt of $12,000 at 7 per cent. The cost of maintenance in 1880 was $800 and the receipts $900.

S. Y. Bradstreet, the Superintendent, is appointed by the City Council.

CCXIII.—EAST SAUGUS.

East Saugus, Massachusetts, in lat. 42° 25′ N., long. 71° 28′ W., is on the Saugus River, near the city of Lynn. Settled in 1629, it was incorporated as a town in 1815. A water supply was introduced in 1877 from the Lynn Water-works, the town of Saugus furnishing the pipes.

The distribution is by 1¼ miles of 8×6 in. wrought-iron and cement pipe, with 12 fire hydrants, 12 gates and 60 taps. The town pays $10 per hour for the time the fire hydrants are used.

Cement-lined wrought-iron services are used.

The population supplied is about 700.

The works cost $5,500. The city of Lynn keeps them in repair, and receives the water rents.

CCXIV.—HANNIBAL.

Hannibal, Missouri, in lat. 38° 44′ N., long. 91° 23′ W., is on the west bank of the Mississippi River. It was incorporated as a city in 1845.

Water-works were built in 1879-80 by a private company, after the plans of Charles A. Smith, C. E., and under the superintendence of Thomas N. Boutelle, C. E. Water is taken from the Mississippi River, ¾-mile above the city. A 16-in. cast-iron pipe extending to the mid channel, 165 ft. from the shore and 6 ft. below the surface, conducts the water to a screen well at the edge of the bank where it passes through copper ¼-in. screens to a filter well where it is passed through 3 ft. of sponge and 2 ft. of sand, gravel and charcoal to a settling well holding 250,000 gallons. The filter will pass 800,000 gallons per day effectually, and is provided with a by-pass in case more water is needed. From the settling well, the water is pumped by a Blake duplex and non-condensing engine with steam cylinders of 24-in. and water cylinders of 14-in. diameter and 24-in. stroke, into a reservoir built in excavation and embankment, puddled and lined with limestone pavement, holding 150,000,000 gallons at 210 ft. above the city. The pumps can also deliver directly into the distribution pipe, of which 10.92 miles are laid of cast iron of 14-in. to 4-in. diameter, and 1.07 miles of wrought iron of 3 and 2-in. diameter.

There are 79 fire hydrants, 72 gates, 600 taps and 5 meters in use. The city pays $66⅔ per year for each of 75 hydrants and $60 each for all over that number, and also $60 each for 3 public fountains. The company furnishes water without charge to a fountain in the public square. The population in 1880 was 14,613, and the daily consumption 2,7,640 gallons.

The capital stock of the company is $100,000.

The works have cost $102,718.95. There is a bonded debt of $90,000 at 7 per cent. Further financial statistics are not given.

J. H. Decker is the Engineer and General Manager.

CCXV.—NANTUCKET.

Nantucket, Massachusetts, in lat. 41° 17′ N., long. 70° 5′ W., is on a low island in Nantucket Bay. The town is mostly of frame houses and is closely built along the shore of the harbor. It was settled more than 200 years ago. Water-works were built in 1878 by a private company, after the plans of Moses Jay, Jr.

The supply is taken from Wannacomet pond, a natural lake of 8 acres area and 25 acres water-shed. It is 2 miles west of the town, between low hills. It is 18 ft. deep in the middle and its surface is 6 ft. above sea level. The water, which is largely supplied from springs in the pond, is very pure. A duplex Blake pump, with 8-in. steam and 6-in. water cylinders of 10-in. stroke, erected in 1878, and a duplex Worthington pump, with 18½-in. steam and 14¼-in. water cylinders of 10-in. stroke, erected in 1880, pump the water into an iron tank 25 ft. in diameter and 16 ft. deep, placed on 9 iron columns on a hill at the side of the pond, the top of the tank being 100 ft. above sea level. The only pipe is led into the bottom of the tank. In case of fire the tank connection is shut off and the engines pump directly into the distribution. The ordinary pressure varies from 18 to 38 lbs. in different parts of the town. The fire pressure is 90 lbs. The main pipe from the pond to the town is cast iron, of 8-in. diameter. In the town there are 2.6 miles of 6-in., 4-in. and 2-in. pipe, with 200 taps. Service pipes are of lead. The town has not yet taken water for fire purposes. The population is 3,900, and the daily consumption in 1880 was 28,000 gallons.

The capital stock of the company is $30,000. Further financial statistics are not furnished. William F. Codd is the Secretary and Superintendent.

CCXVI.—MILLVILLE.

Millville, New Jersey, in lat. 39° 24′ N., long. 75° 2′ W., is on the Maurice River, a small stream emptying into Delaware Bay. The town is on level ground. Settled in 1800, it was incorporated as a village in 1866. Water-works were built in 1878 by a private company, after plans of Emile Geyelin, C. E., taking the supply partly from a well and partly from a pond of 1,100 acres area formed by a dam across the river, one-half mile long, 20 ft. high, 20 ft. wide at top and 60 ft. at bottom. Pumps of 10-in. bore, driven by water-power, lift the water 128 ft. into a stand-pipe of ⅜ in plate-iron, 12 ft. in diameter and 130 ft. high.

Distribution is by 10 miles of cast-iron pipe of 12-in. to 4-in. diameter, with 66 fire hydrants and 236 taps. Three meters are in use. The town pays $2,400 per year for use of hydrants. Service pipes are of lead.

The population in 1880 was 7,060. The consumption is not stated.

The capital stock of the company is $63,000. No further financial statistics are given. Joseph McChesney is Secretary of the company.

CCXVII.—VALLEJO.

Vallejo, California, in lat. 38° 10′ N., long. 122° 13′ W., is on the Straits of Carquinas in San Pueblo Bay, 28 miles north of San Francisco. The city is in a rolling country. It was settled in 1852. Water-works were built in 1871 by a private company after the plans of Hermann Schuessler, C. E., taking the supply from a lake of 10 square miles water-shed, 3 miles northeast of the city, and having 160 acres area, created by a dam of earth 300 ft. long and 40 ft. high. A 12-in. cast-iron pipe conveys the water to the city. About half the city is supplied by gravity. For the rest the water is pumped by two Hooker pumps, 100 ft. into a reservoir of 500,000 gallons capacity on Capiton Hill, 150 ft. above tide level.

For distribution wrought-iron pipe was first used. It lasted from 6 to 8 years and has been mostly replaced by cast iron. There are now in use 18 miles of pipe of from 12-in. to 1½-in. diameter, with 35 fire hydrants, 25 gates and 1,100 taps. 12 meters are in use. The town does not pay for use of hydrants. Service pipe are principally of ¾-in. galvanized iron.

The population in 1880 was 5,000 and the daily consumption 60,000 gallons.

The capital stock of the company is $1,000,000. The works have cost $250,000. There is no debt. The expenses in 1880 were $10,000 and the receipts $24,000.

A. J. McPike is the Superintendent.

CCXVIII.—WINGHAM, CAN.

Wingham, Canada, in lat. 44° N., long. 82° W., is on the Matland River. It was incorporated as a village in 1873, with 700 inhabitants, and as a town in 1878. Water-works were built in 1880 by the town after the plans of Thomas H. Tracey, C. E. The supply is taken from the river and is pumped directly into the mains by two double-acting piston pumps of 10-in. bore and 22-in. stroke, driven by a 56-in. turbine wheel under 12-ft. head.

One mile of 6-in. cast-iron pipe is laid with 6 double nozzle hydrants. The water is used only for fire purposes. The population in 1880 was 3,000. The works cost $8,000, which is the amount of the bonded debt bearing interest at 6 per cent. The cost of maintenance in 1880 was $240.

W. W. Inglis is Chairman of the Fire and Water Committee of the Council, which controls the works.

CCXIX.—EBENSBURG.

Ebensburg, Pennsylvania, in lat. 40° 30′ N., long. 78° 42′ W., is 2,000 ft. above sea level, in the Allegheny Mountains.

Settled in 1795, it was incorporated as a borough in 1806. Water-works were built by the borough in 1874, after the plans of James Williams, taking the supply from a 5½-in. bored well, 1,000 ft. deep. A 3-in. brass pump, operated by a windmill, supplemented by steam power, lifts the water 30 ft. into a stone reservoir 50 ft. in diameter and 10 ft. deep, placed 75 ft. above the town.

The well will yield about 12,000 gallons in 10 hours. Distribution is by 1¼ miles of 6 and 4-in. cast-iron pipe, with 16 fire hydrants, 5 gates and 40 taps.

Services are of ¾-in. wrought-iron pipe.

The population in 1880 was 1,160. The consumption is not stated. The works have cost $16,000. There is a bonded debt of $8,200, bearing interest at 4 per cent. The receipts in 1881 were $1,100.

Hosea J. Evans is the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks: From W. W. Inglis, Chairman Fire and Water Committee, statistics of the water-works of Wingham, Ontario, Canada. From Edw. Pierson, Secretary and Treasurer, statistics and water rates of the water-works of Morristown, N. J. From John Lockwood, Esq., statistics and water rates of the water-works of New Brighton, Staten Island, N. Y.

From Edwin Darling, Superintendent, the second annual report Water Commissioners and Superintendent Water Work of Pawtucket, R. I.

FRACTURE OF RAILS.

From observations made on Russian railways it appears that the frequency of fractures of steel rails rises as the temperature falls, the percentage of breakages having been found highest in March (18 per cent.), and lowest in June and August (3 per cent.) The same condition has been observed to prevail on German railways in the case of ties. From figures published we learn that from Oct. 1, 1879, to March 31, 1880, 480 fractures of tires, or 18.9 per cent., occurred while the temperature was above zero; 105 fractures, or 4.1 per cent., at zero, and 1,952 fractures, or 77 per cent., at temperatures below zero. The greatest number of fractures happened on Dec. 9, 10, 17 and 23, 1879. Tires of fine-grained iron and puddled steel appear to be safer, while ingot steel offers greater advantages as to wearing.

ANNUAL REPORT OF THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.

Continued from Page 63.

ex-President Metcalf, and at his left, Vice-President Rodd, the keen, bright-faced young light of the Pennsylvania Company's draughting department. About the table were men whose thought, wedded to the product of Pittsburgh's great workshops, finds embodiment in a hundred enduring structural forms. There were bridge builders and machine makers and road builders and iron founders; thoughtful-looking men whose calling left its impress on their faces, and whose names are familiar in all parts of the country.

Having called the attention of all present by a smart rapping upon the table, President Gottlieb, in a few well-chosen words, asked the Society to give heed to the first toast. He proposed "Our Society," and called Mr. S. M. Wickersham to respond thereto. That gentleman reviewed briefly the elements contained in the society, the work which had been accomplished by the members, and the impress their labors had left on the varied industries of this city. The gentleman concluded by reference to the notable output attained by blast furnaces in charge of a member of the society, and alluded to the generosity of another member (A. Carnegie), who offers a quarter of a million to the city where his industries are located.

Ex-City Engineer Dempster was called upon to respond to the sentiment, "Our Ex-President." In so doing Mr. Dempster lapsed into verse, neatly embodying complimentary allusions to Mr. Metcalf.

That gentleman, greeted by cheers, rose to his feet and replied fittingly to Mr. Dempster's effort. He then gave a scientific analysis of the diagram handed him by Secretary Harlow, representing the table and the assignment of seats. This was followed by a forcible little speech on the evils of the lowest bidder system.

"Hammer and Tongs" was assigned Mr. Wm. Miller, the veteran of the Duquesne Forge. The speaker referred to the hammer of the ancients, traced its slow development and evolution until the advent of the Nasmyth hammer, many years ago. The gentleman had trudged miles in old Scotland to witness the first blows of the first Nasmyth hammer, and stated that, though 23 years ago, Everson, Preston & Co. operated the only steam hammer in this city, he was proud to learn that there were 239 hammers hung in rolling mills, 219 in steel works, and 141 in forges and bloomeries, a total of 599 hammers; and among them the Park hammer, the largest in the United States.

Mr. M. J. Becker, chief of the Engineering Department of the Pennsylvania Railroad, responded to the semi-facetious sentiment "Raillery." The gentleman held that the word given him was a queer one, and that the Committee on Toasts ought to be held accountable for such a selection. In fact, he disliked committees utterly, and had learned that the cleverest man, when he became a member of any committee whatsoever, straightway lost all his good qualities, becoming tyrannical, despotic and altogether hateful. He had just returned from a ten days' tour over the line of the Pan-handle road, and was in no fit condition to make a speech. If any member of the Society wanted to know what the speaker had to say about rails or railways, he would ask them to call at his office after 10 o'clock next day.

Wm. Thaw, Jr., rose to respond to the toast, "General Engineering." The speaker, as the chairman of the committee arraigned by Major Becker, asked a suspension of judgment on committees, and defended his committee's selection of the toast "Raillery." Mr. Thaw delivered a graceful and timely speech, and was warmly applauded.

"The Bridge of the Future" brought out a thoughtful and interesting address from Mr. G. Lindenthal. His views regarding the cause of deterioration of iron in bridges by oscillatory and vibratory motion were well expressed and were new to at least a portion of his hearers. The weight and speed of trains now called for special skill and care in the construction of bridges, and the speaker deprecated the prevailing ideas of railroaders to the effect that a long span iron bridge could be contracted for one month and finished the next. Mr. Lindenthal gave some interesting facts relating to his examination of portions of a bridge thirty-seven years old, showing the serious depreciation in the wrought-iron eye bars and little or no depreciation in the wire cables.

"The Press" was responded to by a representative of *The Telegraph* (from whose columns we take this report), after which Mr. Miller was asked to tell what he knew about "cranks," on the ground that the gentleman's years of experience in forging them entitled him to an inside track towards information. Mr. Miller remarked that as a rule cranks should be shrunk tight, have plenty of "throw" and a good "drop."

Capt. Paul Rohrbacher, being called upon to say something, delivered one of the best efforts of the evening, and concluded by earnestly advocating the establishment, in this city of great industries, of a technical school, on a scale commensurate with the peculiar needs of this community. The gentleman was warmly applauded. Mr. C. H. Kloman yielding gracefully to the combined pressure of the Society's members, sang Foster's "Swanee River," followed by "John Brown's Body," in both songs having the hearty support of the Society lungs and larynxes. It being then past midnight the banquet ended.

RECENT INVENTIONS.

A new method of opening up channels through sand bars consists in driving a number of piles along the course of the desired channel. It is asserted that the action of moving water against and around these piles will effectually remove and wash away the sand.

While the memories of the railroad accident at Spuyten Duyvil Creek are fresh in the minds of the people, increased importance will be given inventions which will lessen the danger to travelers. A novel invention of this class consists in combining with the semaphore arm or other visual signal, a rotating arm, arranged when a switch is misplaced to lie across the path of an audible signal on the locomotive. When the visual signal is at "danger" an alarm will be given upon any passing locomotive.

A new lock and signal for railroad draw-bridges consists of spring-impelled bolts arranged on either end of the draw, and having connecting rods attached to the bolts at one end, and at the other, respectively, above and below the pivotal point of a centrally-arranged lever and rack bar. These locking bolts work in mortises in the draw-bridge abutments. When the draw is open, gravity signals suspended over and to the side of the track fly to "danger." The return of the draw to its normal position serves, through the action of the bolts, to return the signals to "safety" position.

A late invention in electrical railways for street cars provides a street car with an electro-motor in connection with a suspended insulated wire over the track and above the car, and with an electro-generator located at some point along the line. A sheave is arranged to travel on the suspended wire, and has a depending wire connecting said sheave and the electro-motor on the car, the wire serving to transmit the current to the car. One of the track rails serves as a return conductor.

Another means for providing additional protection to travelers consists of maintaining a break in one of the rails of a siding, whereby shunted cars are prevented from returning and fouling with the main line. The rod operating said spring-rail has a spring connection, whereby, if the switch were reset to the main line before the car in shunting had reached and passed the break, the wheels of the car would spring said rail into line when merely passing.

A novelty in the construction of passenger locomotives consists in arranging the driving-wheels above the track in such manner that they rest upon and between smaller truck wheels, and to which they communicate motion through frictional contact. This construction admits of a higher degree of speed than is attainable under the ordinary arrangement of driving-wheel.

We chronicle this week an invention designed to do away with the vibrating diaphragm of the mouth-piece of a telephone, which will be, perhaps, interesting to the readers of this paper. A thin sheet of resonant metal, susceptible of magnetic induction, is bent into conical or funnel shape, with two of its edges in close proximity, but not meeting. A helical wire is wound on one of these edges, parallel thereto, and connecting with the main line. This construction, it is said, admits of the transmission and reception of articulate speech, without the employment of a diaphragm.

F. B. BROCK.

CORRESPONDENCE.

METRIC PROFILE PAPER.

BOSTON, Feb. 7, 1882,

EDITOR ENGINEERING NEWS:

In a letter published in your paper of Jan. 7 last may be found some suggestions concerning the ruling to be used for metric profile paper. The designs there described are, however, not sufficiently general in their application, neither are they based upon sound *decimal* principles, being adapted to the use of the 25 meter chain, which does not belong to the standard linear measures of the metric system, as was explained in your number for Jan. 28.

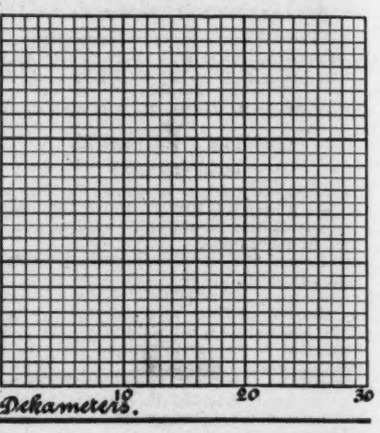
Let us examine the subject from a purely metric stand-point.

It is for many reasons desirable that the different designs of metric profile and cross-section paper should be as few as possible. This may be best accomplished by giving to each design a purely decimal character, so that it may be used for a variety of different scales and ratios of distortion, giving especial prominence to those scales that are most commonly employed.

The valuable principle of doubles and halves, described in your issue of Jan. 28, upon which the standard series of metric measures is based, is also extended to the draughting scale, and the half centimeter, centimeter and double centimeter, with their sub-divisions of millimeters, half millimeters and double millimeters, although not embracing all the metric draughting scales, are probably used more commonly than any other.

Profile and cross-section papers are draughting scales in their nature, and by limiting them to designs based upon the half centimeter, the centimeter and the double centimeter, most, if not all, of the wants of railroad engineering, hydraulic engineering and general physical experiments will be met.

The metric profile paper already published by J. W. Queen & Co. furnishes, in the most perfect manner, the scales of the half centimeter and the centimeter; no profile paper based on the double centimeter seems, however, to have been published in this country, and the following design is recommended to supply the want:



The lines of the diagram are two millimeters apart, both horizontally and vertically, every other line being slightly heavier and every tenth line still heavier. This ruling brings out squares of two centimeters in strong relief, while the intermediate ruling favors the use of the standard 20 meter chain in railroad work. The numbering of the lines in the diagram is such as to make a horizontal scale of 2 centimeters to 100 meters, or $\frac{1}{5000}$, and a vertical scale of 4 millimeters to 1 meter, or $\frac{1}{250}$, making a distortion of 20 to 1. These are the scales contemplated by the writer of the communication in your issue of Jan. 7, and, as is there shown, are very nearly the same as those commonly used with measures in feet.

The diagram may also be figured, in each direction, for either of the following scales, referring to natural size,

$\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{100}$, $\frac{1}{200}$, $\frac{1}{1000}$, $\frac{1}{2000}$, etc.

By variously combining the horizontal and vertical scales, work may be plotted to a *natural scale* or with such distortions as 5 to 1, 10 to 1, 20 to 1, etc.; a range of possible combinations that would seem to meet any ordinary case.

Profile paper of this kind, together with the kind already published by Mr. Queen, would seem to the writer to meet all the orinary cases of civil engineering. As both designs are purely decimal in each direction they may also be used as cross-section paper if desired—a very valuable simplification of engineering stationery.

CHARLES H. SWAN.

CENTER OF GYRATION.

A correspondent asks the meaning of the term "radius of gyration," in the denominator of the fraction expressing the compressive strains in columns or struts.

According to Rankin (Applied Mechanics, p. 361), "the additional strain due to direct pressure is in a ratio which increases as the square of the proportion in which the length of the pillar exceeds the *least diameter*, or" $\frac{l^2}{h^2}$. And in Gordon's formula, so-called, h is taken "to represent the diameter of a pillar or strut in that direction in which it is most flexible." We judge that l^2 in the formula of our correspondent, is the h^2 of Gordon, which some wiseacre has chosen to characterize as the "radius of gyration."